UDC 65.011.56:666.1.031.2:666.1.031.8

DEVELOPMENT AND IMPLEMENTATION OF AUTOMATIC CONTROL SYSTEMS FOR GLASS-MELTING FURNACES

A. A. Dobrolyubov[1] and A. I. Figurkin[1]

The main directions of R&D of the Automation Department at the Research and Development Institute of Glass are described. The advantages of the developed systems are discussed, and examples of the implementation of automatic systems at glass factories are described.

Glass factories often encounter difficulties related to the problem of precise regulation of the preset parameters of the glass-melting process, due to the poor quality or lack of automatic control devices. This leads to an increased quantity of defective products. Furthermore, production expenses grow as a result of increased material and fuel consumption, various technological problems arise, etc. That is why automation of the technological process is of supreme importance.

More than 10 year ago, the Research and Development Institute of Glass, on the basis of its automation laboratory, created the Automation R&D Department consisting of Research, Design, and Start-up teams, which makes it possible to execute "turn-key" projects. The Department develops, makes, and installs automatic control systems for glass factories. The main research directions include the development of automatic control systems for glass-melting furnaces, feeders, annealing furnaces, transporters, and glass-strengthening units. In addition to that, specific research efforts are directed to improving automatic systems, for instance, increasing the reliability and precision of the system for controlling the glass melt level, implementing a telemetric system for the monitoring of the melting process, expanding the elemental basis for automatic systems, and implementing the latest up-to-date achievements in the production of devices for control and regulation of technological processes.

The automatic systems for controlling glass-melting furnaces (AS GF) are made based on domestic and imported microprocessor controllers that ensure maintenance of the main glass-melting parameters (glass melt level, pressure, temperature, air : fuel ratio, and modification of the flame direction). The control systems for flame and electric furnaces are based on microelectronic regulators. The department produces 5 to 10 systems of that type per year.

The developed and currently produced AS GF use domestic Remikont R-130 and OMRON (Japan) microprocessor controllers as regulators.

Technological processes are monitored using a data-control system connected to a personal computer.

The computer system has the following functions:

– displaying the process taking place inside the furnace, supplying digital data on investigated parameters;

– automatic storing of the most important parameters (furnace temperature and pressure, glass melt level, gas consumption) in the form of plots for at least three days;

– viewing plots by moving the cursor along the plot;

– signaling a parameter deviation beyond the preset limits (flashing or change in color intensity);

– the possibility of connecting a printer for recording the time and type of malfunctions on paper.

Two operating modes are provided in the automated control system for the glass-melting process: automatic control (the standard mode) and remote control (from the OMRON control panel or a manual control block) to be used during repair and adjustment work.

The AS GF, including the computer-controlled systems, are made in the form of two control panels (2000 × 800 × 600 mm for the automatic system for the glass-melting furnace). The Department also supplies individual elements of AS GF, in particular, the glass melt level control system (SUS-3) in various modifications. The precision of the glass melt level control is ± 0.2 mm.

The indicated automatic systems were implemented by a number of production companies, in particular, the Chagodoshchenskii Glass Factory (Vologda Region), Experimental Glass Factory (Gus-Khrustalny), Krasnoe Ékho JSC, Tveris Company, and many others. The users report reliable, failure-free service of the automatic systems.

[1] Research and Development Institute of Glass, Moscow, Russia.

In addition to the control systems for glass-melting furnaces, much attention is paid to automatic control systems for glass-melt feeders. These systems include a temperature control panel based on domestic or imported elements and a gas-mixing station based on German equipment. The accuracy of automatic maintenance of the temperature in specific zones of the feeder is $\pm\,0.5\%$. This system can be controlled manually as well, employing local regulators.

Implementation of different automatic control systems developed by the Department will make it possible to significantly reduce fuel and material consumption, improve product quality, and increase the reliability of thermal machines and equipment.